TABLE I. Absorption cross sections (in cm²) of several atmospheric gases at Lyman alpha.

Gas	Value by Preston	Our value
N_2	$<2.0\times10^{-22}$	$<3.0\times10^{-22}$
O_2	1.04×10^{-20}	1.0×10^{-20}
CO_2	7.5×10^{-20}	7.3×10^{-20}
H_2O	1.45×10^{-17}	1.44×10^{-17}
O_3		2.4×10^{-17}
CH_4		1.78×10^{-17}
NO		2.5×10^{-18}
N_2O		2.4×10^{-18}
NH_3		7.1×10^{-18}

abruptly at 1345A or 9.20 ev. Rather high yield was obtained over the entire region down to 1070A. Even with narrow slits (0.05 mm) giving a band width of 0.85A the ion current was as high as 5×10^{-11} amp (at Lyman alpha). From the light-intensity measurement based on previous thermocouple data,[11] it was found that photoionization accounted for about fifty percent of the total absorption at Lyman alpha. Thus, the ionization cross section for NO is about twenty-five times larger than the estimated value.[3]

The width and the transparency of the oxygen windows in region *B* are such that photons of required energy, particularly Lyman alpha, can penetrate deep into the *D* layer. In anticipation of the importance of Lyman alpha, absorption cross sections of several gases are listed in Table I, together with those obtained by Preston.[12]

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Lyman Alpha-Line Photographed in the Sun's Spectrum*

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MEMBERS of the Physics Department of the University of Colorado at Boulder have succeeded in obtaining a picture of the sun's spectrum from an altitude of over fifty miles above the surface of the earth. By means of precision instruments sufficiently rugged to withstand high acceleration installed in the nose cone of an Aerobee rocket, a film was exposed, and the radiation from the sun in the far ultraviolet was recorded in regions heretofore not photographed. The results of this work were first reported as a post-deadline paper on January 22, 1953 at the Harvard University, Cambridge, Massachusetts meeting of the American Physical Society.

During the past three years a number of physicists at Colorado have been working on a sun-seeking device or pointing control for installation on high altitude rockets. This is an exceedingly complicated electronic and mechanical device to hold an instrument pointing at the sun during the flight of the rocket which may roll and yaw.

On December 12, 1952 an Aerobee rocket was fired from the Holloman Research and Development Center, New Mexico, carrying the University of Colorado pointing control and spectrograph. This is the first instrument of its kind which pointed directly at the sun for a considerable period. An exposure was taken for 28 seconds and a photograph of the sun's spectrum was obtained. Where previously scientists had photographed the spectrum to about 2000A, in this experiment for the first time the radiation in the far ultraviolet emitted by the hydrogen in the sun has been photographed. Much of this radiation is concentrated in a spectrum line at 1216A, namely the Lyman alpha-line. On the day of the flight the solar activity, represented by hot spots or flares, was reported by the Harvard-Colorado High Altitude Laboratory as being slightly above normal.

On the film the Lyman alpha-emission line at 1216A stands out clearly above the background density. A preliminary examination of the film indicates that the width of the line may be approximately six A and that the intensity of the Lyman alpha-emission outside of the earth's atmosphere may be of the order of 0.03 microwatt per square centimeter. A more careful analysis is being made, and the results will be reported in the near future.

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Helium II Film Transport Rates over Various Surfaces*

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THE experimental investigation of the helium II film transport rate over various surfaces, previously reported from this laboratory,[1,2] is now being reviewed and extended. Although the present work is still in progress, a brief summary of certain results appears to merit presentation at this time, especially in view of a recent publication by Chandrasekhar.[3]

The transport rates tabulated below were obtained by means of the capacitor depth gauge method,[1,2] modified to improve the precision of the measurements. In the present arrangement, transport vessel-capacitors were constructed so that a recording potentiometer not only indicates the motion of the liquid level but also registers the time required to empty (or fill) various sections of the transport vessel. This elapsed time, when correlated with the appropriate volume and limiting perimeter, leads directly to a rate determination. Values cited in Table I are taken from smooth curves constructed in most cases from fifty or more individual rate measurements taken at temperatures between the lambda-point and just below 1°K.

TABLE I. Transport rate in cm³/sec-cm ×10⁵.

	1.0°	1.2°	1.4°	1.6°	1.8°	2.0°
Lucite	···	12.2	11.6	11.0	8.9	4.7
Machined nickel	···	14.8	14.6	13.8	11.3	6.8
Machined nickel[a]	13.8	13.7	13.4	12.3	9.8	5.7
Pyrex (ordinary)	···	9.6	9.5	9.1	7.4	4.4
Pyrex (precision bore)	11.8	11.6	11.2	10.3	8.3	4.9
Quartz (transparent)	10.4	10.0	9.5	8.6	7.2	4.3
Quartz (translucent)	11.2	10.7	10.0	8.6	7.7	5.0
Machined thorium[b]	···	40.9	39.1	36.1	28.5	15.5
Machined thorium[c]	···	16.5	16.2	14.6	11.5	7.1

[a] After removal from cryostat and reinstallation and measurement three months later.
[b] Averaged over entire vessel.
[c] At bottom of vessel.

The Lucite measurements previously reported were noted as tentative.[1,2] The current data (using the same beaker with a new capacitor depth gauge) duplicates neither the peak of the earlier report nor the maximum noted by Chandrasekhar.[3] Instead the results show a smooth rate-temperature variation whose absolute values are in agreement with the earlier curve omitting the peak.

Previously the absence of data for the low temperature expansion coefficient of Lucite prevented adequate correction for the contraction of this material. The present values are corrected for this effect.[4,5]

It is interesting to note that in carrying out a long series of measurements on nickel we obtained in one instance a transport rate curve characterized by a maximum of the type which has on occasion been reported not only for methyl methacrylate polymers,[3] but also for glass[6-8] and platinum.[9] However, on prior and subsequent runs a reproducibly different and more conventional rate-temperature variation was obtained. These rates, noted in the table, are substantially lower than those reported by Mendelssohn and White for a nickel beaker which had been "dipped into warm hydrochloric acid."[9] This is in general agreement with the previous observation that higher rates are obtained for etched metal surfaces.[1,2]

The results obtained for glass in this and other investigations,[7,10-12] when considered in conjunction with the known properties of glass surfaces,[13-15] suggest that a unique rate of transport over glass should not be expected.

Fused quartz (both transparent and translucent) was chosen as a source of data on vitreous materials other than glass. Data obtained by direct visual observation of transport using a clear quartz capillary were in excellent agreement with the results of electrical measurements.

Thorium fulfills the requirement of being a superconductor whose transition temperature is located in the region where the film transport rate is a slowly varying function of temperature. If there is an interaction between the film and the underlying surface which is altered by the onset of superconductivity, it might be expected to be most clearly distinguishable under such conditions. The zero-field transition temperature of our sample was determined by an induction method. The result, 1.38°K, is in good agreement with that of Shoenberg.[16] The transport data thus far obtained (on widely separate occasions) are characterized by an extreme height dependence and, in the region below about 1.4°K, by anomalously high scatter. Pending further investigation, the origin of this unusual behavior remains unexplained.

In conclusion we note that after suitable normalization at 1°K, the data cited above do not yield a universal curve for the temperature dependence of the transport rate.

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Activity Assignment to Titanium 51

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To the isotope Ti^{51} have been attributed three activities with half-lives 2.8 minutes,[1] 6 minutes,[2] and 72 days.[3] The first[2] and last of the above three activities have been removed. During a neutron irradiation a small amount of hafnium impurity in the titanium was shown chemically to be responsible for the 72-day activity.[4] The 6-minute activity has been confirmed[5] with slow neutron irradiation but not with chemical separations. Since there are serious obstacles in rapid titanium chemical separations, it was thought that a series of cross bombardments with appropriate particles and enriched isotopes[6] would be capable of removing any doubt as to the existence of a 6-minute activity attributable to Ti^{51}.

$Ca^{48}(\alpha, n)Ti^{51}$: Calcium carbonate, enriched in isotope of mass number 48 from normal abundance of 0.15 percent to 7.49, was bombarded with 20-Mev alpha-particles from the cyclotron. Since the abundance of Ca^{40} was still very high, 89.68 percent, the 3.9-hour Sc^{43} positron activity was so intense that decay readings were necessarily made in a magnetic spectrometer. Figure 1 shows the half-life to be 5.92±0.15 minutes after the 3.9-hour annihilation background activity was subtracted.

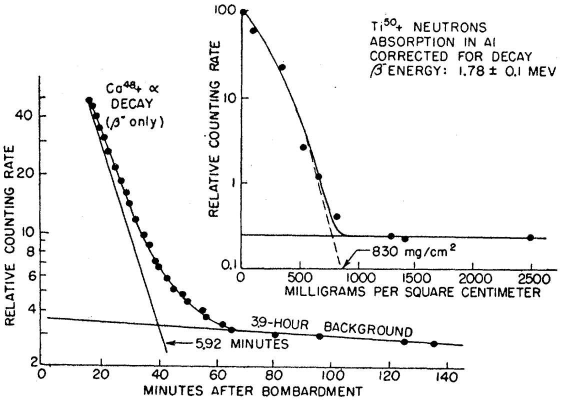

FIG. 1. Decay of Ti^{51} from $Ca^{48}+\alpha$ and absorption of negatrons of Ti^{51} from $Ti^{50}+n$.

$Ti^{50}(n, \gamma)Ti^{51}$: Titanium oxide enriched in isotope of mass number 50 from normal abundance of 5.34 percent to 84.69 was irradiated with neutrons slowed down in paraffin from a proton bombardment of beryllium. A half-life of 5.89±0.15 minutes was observed. Figure 1 also shows an absorption curve. The beta-energy was found to be 1.78±0.1 Mev which compares favorably with the two previous values of 1.6 Mev[7] and 2 Mev.[2]

A gamma-ray was evident in the Ti^{51} activity, although it was not specifically investigated here. The energy has been reported as 0.320 kev.[7]

$Cr^{54}(n, \alpha)Ti^{51}$: Chromium oxide, enriched in the isotope of mass number 54 from normal abundance of 2.30 percent to 83.1, was irradiated with fast neutrons. The 6-minute activity was again clearly observed. The presence of 3.7-minute activity V^{52} prevented an accurate half-life determination.

$V^{51}(n, p)Ti^{51}$: Vanadium metal when irradiated with fast neutrons yielded the 6-minute activity and again the interfering 3.7-minute activity.

From the four types of reactions, a consistent 6-minute activity was observed with an average half-life of 5.89±0.2 minutes, negatrons of energy 1.78±0.1 Mev, and a low energy gamma-ray. A definite assignment can be made to Ti^{51}.

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